View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by OpenSIUC

Southern Illinois University Carbondale

OpenSIUC

Theses

Theses and Dissertations

12-1-2019

SOCIAL DISCOUNTING OF CLEAN WATER AND ENVIRONMENTAL SUSTAINABILITY

Ashley Katz

Southern Illinois University Carbondale, ashleymoniquekatz@gmail.com

Follow this and additional works at: https://opensiuc.lib.siu.edu/theses

Recommended Citation

Katz, Ashley, "SOCIAL DISCOUNTING OF CLEAN WATER AND ENVIRONMENTAL SUSTAINABILITY" (2019). *Theses*. 2619.

https://opensiuc.lib.siu.edu/theses/2619

This Open Access Thesis is brought to you for free and open access by the Theses and Dissertations at OpenSIUC. It has been accepted for inclusion in Theses by an authorized administrator of OpenSIUC. For more information, please contact opensiuc@lib.siu.edu.

SOCIAL DISCOUNTING OF CLEAN WATER AND ENVIRONMENTAL SUSTAINABILITY

by

Ashley Monique Katz

B.S., Illinois State University, 2015

A Thesis
Submitted in Partial Fulfillment of the Requirements for the
Master of Science Degree

Department of Health Sciences
in the Graduate School
Southern Illinois University Carbondale
December 2019

THESIS APPROVAL

SOCIAL DISCOUNTING OF CLEAN WATER AND ENVIRONMENTAL SUSTAINABILITY

by

Ashley Katz

A Thesis Submitted in Partial

Fulfillment of the Requirements

for the Degree of

Master of Science

in the field of Applied Behavior Analysis and Therapy

Approved by:

Dr. Mark Dixon, Chair

Dr. Darwin Koch

Dr. Rachel Enoch

Graduate School
Southern Illinois University Carbondale
November 15, 2019

AN ABSTRACT OF THE THESIS OF

Ashley Monique Katz, for the Master of Science degree in Applied Behavior Analysis and Therapy, presented on November 14, 2019, at Southern Illinois University Carbondale.

TITLE: SOCIAL DISCOUNTING OF CLEAN WATER AND ENVIRONMENTAL SUSTAINABILITY

MAJOR PROFESSOR: Dr. Mark Dixon

The purpose of this study was to examine choice-making as it relates to providing a source of clean water to those at varying social distances. A discounting survey was completed by 65 participants asking them to choose between spending a specified about of money on plastic water bottles that have a 100% chance of harming the environment or spending $1000 on a water filtration system that has a 0% chance of harming the environment. Results indicated that as social distance increased, responding became more impulsive as evident by a steeper amount of discounting. For “Person #1”, 27.69% of participants chose to spend money on plastic water bottles while for “Person #100”, 53.8% of participants chose to spend money on plastic water bottles. The R^2 calculated was 0.8633. Results also indicated that there was a positive correlation between frequency of behaving in sustainable ways and how much one valued the environment, as well as how concerned one was with the environment. Implications, strengths and limitations, and future research opportunities are discussed.

Keywords: social discounting, environmental discounting, environmental sustainability, pro-environmental behaviors

ACKNOWLEDGMENTS

I would like to thank Ayla Schmick for supporting me throughout the process of researching this topic. Her knowledge and encouragement over the past year helped me to be successful not only in writing this thesis, but also through the last semesters of my studies. She gave me positivity and confidence in moments when I needed it and challenged me to keep moving forward. I am very grateful for having the opportunity to work with her and wish her the best of luck in her future endeavors as well!

DEDICATION

This is dedicated to my brother, Brandon, and to my Aunt Ann and Uncle Steve. The three of them have shown me much support in every area of life, but especially during my graduate studies. I would not have been successful in this endeavor without the three of them cheering me on along the way.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

FIGURE PAGE

CHAPTER 1

INTRODUCTION

Environmental Sustainability

It is important now, more than ever, for all disciplines to focus their efforts to improving the environmental condition of this plant and improving and increasing sustainability efforts. We are currently experiencing significant and detrimental problems such as climate change, pollution, massive amounts of waste production, and a decreasing food and drinking water supply, to name a few (Environmental Protection Agency, n.d.a). For the most part, it is common knowledge that the environmental issues we are currently experiencing worldwide are due to human activity. Some activities that are well-known to contribute to these negative consequences include things such as driving and air travel, and agricultural production, to name a few. Compared to 30 years ago, humans are extracting about 50% more of natural resources (Giljum et al., 2009). These resources are quickly depleting and as the human population continues to grow and as our lifestyles continue to change over the years we will not have enough natural resources to sustain us. The effects will only continue to worsen until it is too late. This is why it is completely necessary for everyone on this Earth to come together and make this the number one priority. This is where environmental sustainability comes in.

Environmental sustainability involves the social, economic, and environmental decision-making which supports a positive change for the health of the Earth (Hansmann, Mieg, & Frischknecht, 2012). Different environmentally sustainable efforts may include decision-making for changes to policy, infrastructure, and operations, for example. Sustainability efforts can be done at all levels including in communities, organizations, in production, and at the individual level and can be applied to a variety of areas. The primary goal of environmental sustainability is to combat problems due to climate change and pollution in order to make a healthier Earth.

Climate Change

According to the 5th Assessment Report of the Intergovernmental Panel on Climate Change (Auffhammer, 2018), since the industrial revolution, the average surface temperature of the Earth has increased by 1.5°F and is continuing to increase by 0.36°F each decade. This increase in surface temperature has already started causing problems such as changes in precipitation causing flooding and droughts (Environmental Protection Agency, n.d.b), forest fires, a rise in sea level, higher average temperatures, changes to crop yield, and worsening and more intense natural disasters such as hurricanes (NASA, 2019; Fourth National Climate Assessment, 2018). This will lead to massive emigration to less extreme climates, food and water insecurity for a continually growing population, more vector-borne diseases such as Malaria, and a decrease in biodiversity as well as massive extinction of different species, as it will become more difficult for species to adapt to the quickening changes (Environmental Protection Agency, n.d.a; Fourth National Climate Assessment, 2018) These problems are already extremely costly for private citizens, governments, and corporations due because of associated health concerns, impacts to production, and catastrophic natural disasters (Fourth National Climate Assessment, 2018), and they will just continue to become costlier as problems continue to worsen, effecting more and more people and areas. According to the United States House of Representatives (2019), in the last three years costs associated with natural disasters has already cost the country $150 billion per year, where those same costs were only about $16 billion per year about 30 years ago. They also state that it is expected that costs will exceed $500 billion by the end of the century.

Some have argued that the Sun's energy output could be causing the increase in atmospheric as well as surface temperature of the Earth as it has caused in the past, however thanks to satellite and energy measuring technology, it is proven that any changes of the Sun's

energy output has in no way caused this current climate change to happen (NASA, 2019). In fact, it is known that gaseous chemical compounds are the cause climate change include carbon dioxide, nitrous oxide, methane, water vapor, and of course chlorofluorocarbons (NASA, 2019). According to McNerney (2019), the amount of carbon dioxide that is currently in the Earth's atmosphere is 40% higher than it was during the industrial revolution. This is due not only to things such as the burning fossil fuels for energy, but also because of deforestation as trees use carbon dioxide in their energy cycles (NASA, 2019). This is incredibly alarming, especially when production of goods using fossil fuels such as plastics is continuing at a substantial rate.

Human Consumption and Plastic Waste Production

Another area of concern regarding the impact of human activity on the environment is the amount of waste production due to human consumption. Humans consume more goods than they used to. This could be due to how lifestyles have changed over time, with more households having two individuals working outside of the home than before. Many times, humans consume things not because they are needed, but because they are convenient or desirable. Consider technology like smart phones and other devices. A lot of people will seek out the newest models even though their older model is still functioning fine. Or consider disposable single-use plastics such as straws, microwave dinners in their plastic packaging, and disposable plates and utensils. These types of plastic items are a frequent topic of discussion because of how much of an impact they have had on the Earth.

Mass-production of plastics began in the 1950s (Kurtela & Antolovic, 2019) and now 50% of that produced is used in products such as straws, bottles, cutlery, bags, and other single-use type items (Nerland et al., 2014). Production of plastic became popular due to its low cost, light weight, and convenience. For many people, it is difficult if not impossible to imagine a life without plastic. The world's production of plastic reached 311 million tons in 2014, which is

about three times the amount than the 25 years prior (Detloff & Istel, 2016). The problem with plastic is first off, the fact it is created with petroleum, which has its own detrimental effects on the Earth. Secondly, plastic does not technically decompose; instead it turns into microplastics, which is when it degrades into small and smaller pieces of plastic. There are two types of microplastics: primary and secondary. Primary microplastics include polyethylene fibers typically found in things such as toothpaste, facial scrubs, and other cosmetics, as well as some cleaning supplies, and secondary microplastics include those larger types of plastics that have broken down into pieces 0.55 centimeters or smaller (Moore, 2008). Plastic can take up to 1000 years to decompose in these landfills (Aldred, 2007), with items such as bottles taking around 450 years to degrade and bags taking 25 years to degrade (Detloff & Istel, 2016). This is a major concern as these are some of the most common items that are used by humans across the globe and much of this waste ends up in landfills, incinerators, and the ocean, all of which have terrible effects on the environment.

Currently, about 75% of all material in landfills is recyclable (Sustainable Foodservice Consulting, 2016) and of the 311 million tons of plastic that is produced each year to make various products, only about nine percent of it is recycled (Matsumguma et al., 2017). Not only is this wasteful in the sense more resources are being used, but it is also taking up a vast amount of space in landfills and on the Earth. There were 7,683 available landfills in 1986, however only 1,908 were available in 2009 (Environmental Protection Agency, n.d.c). It is estimated 60% of the plastic that has ever been produced end up in these landfills (Geyer, Jembeck, and Laws, 2017) and there is no doubt that this amount of waste production are the cause of the decreasing amount of space for landfills. If the amount of plastic production does not decrease and the amount of plastic recycled increases, there is just no way the Earth can sustain the space to fit all this plastic, which is how much of it is ending up in the ocean.

It is estimated that each year, anywhere from 4.8-12.7 million metric tons of plastic end up in the ocean (Van Cauwenberghe et al., 2014). This number is difficult to estimate because of the fact much of the plastic ends up becoming microplastics due to deterioration from the sun or from salt water and these microplastics are almost impossible to see with the naked eye. Detloff & Istel (2016) state that 70% of plastic is at the bottom of the ocean, while 15% hovers in the water column, and only about 15% floats on the surface (UNEP/WHO/IAEA, 1988). It is estimated that about 60-95% of all the solid pollution in the ocean is made up of plastic (Kertela & Antolovic, 2019), and Jambeck et al. (2015) suggest that 80% of this plastic that ends up in the ocean actually enters it from land due to reasons such as littering.

According to Nerland et al. (2014), the two most common types of polymers in the microplastics that end up in the ocean include polypropyfene (40%) and polyethylene (50%). These then end up being ingested by marine species either through their mouths or gills and may cause a multitude of problems such as gastrointestinal blockage, problems with reproduction, malnutrition, and even death (Baulch and Perry, 2014). There are approximately 660 different types of marine life that are affected including fish, dolphins, sea turtles, and coral (Detloff & Istel, 2016). Marine life are not the only organisms affected. It starts with the smaller fish consuming these plastics, who are then consumed by larger fish and so on as it moves up the food chain until eventually these microplastics are being consumed by land animals such as birds and humans (Browne et al., 2013). Despite the fact most people know the environment is suffering and that there is an influx of plastic in the oceans and covering the Earth, they continue to use these single-use plastic items, litter them, or just not recycle them, but why?

Values

Values are defined as “verbally constructed global desired life consequences” (Robb, 2007). They are essentially what individuals identify as being most important to them in their

life and serve as a sort of motivation for the actions that are taken through life. Values may be influenced from one's past experiences and how they have behaved in the past (Maio et al., 2003). For example, someone who values family might hold that value because they did not have a good family life growing up and that had a major impact on them. They might then decide to have several children and even sacrifice having a demanding career in order to spend more time at home with their children so that they can experience having a good family life as they grow up. Or consider somebody who is diagnosed with cancer. They might begin to value health more than they did previously and suddenly give up unhealthy behaviors such as smoking, poor diet, and lack of exercise. Instead they may begin using all of their energy to live a healthy lifestyle and even become a health coach or write a book to help others begin to live a healthier life. These are just a couple of examples of values, but there are many values an individual can have, including valuing the environment and living a sustainable life.

It has been found that individuals who value nature and the environment also tend to participate in more sustainable and pro-environmental behaviors (Stern et al., 1995). This does not necessarily mean that those who do hold these values will *always* behave in sustainable ways. This may be due to the fact that many individuals sometimes fail to relate those values with their actions (Maio et al., 2009). This can happen because what one is feeling and experiencing in the present moment is so strong that they may disregard future events, called temporal myopia (Wittmann & Sircova, 2018). Wittmann and Sircova continue to describe that extreme temporal myopia is a characteristic of impulsivity. Consider a graduate student who values the environment, but also values being successful in school and may be experiencing a shortage of time and money. It is very likely that they will end up purchasing individually packaged meals because of the convenience they pose due to their low cost and the minimal to

no preparation that is required to cook it, even though they know this is a choice that is not good for the environment.

The competing values, temporal myopia, and a multitude of other factors that individuals experience play a heavy role in decision making. By having a further understanding of how these things interact and how to change the values individuals hold as it relates to the environment, it will be possible to improve the ways people behave when it comes to the environment. As it stands right now, most of the research and efforts which has been done to improve environmental sustainability has mostly occurred in fields such as the biological sciences, engineering, urban planning, public health, and environmental policy, to name some (Luke & Alavosius, 2012.). Although this research is important, it is missing to touch on this understanding, which explains why humans continue to use products and engage in behaviors they know are contributing to destroying the environment. One discipline that has only recently began looking into improving these efforts is applied behavior analysis.

Behavior Analysis

Applied behavior analysis (ABA) is the application of the science and techniques of learning, primarily understood thanks to the earlier research of Thorndike, Watson, Skinner, and Pavlov (Cooper, Heron, & Heward (2007). Baer, Wolf, and Risley (1968) describe seven dimensions something must possess in order to qualify something as being behavior analytic: applied, behavioral, analytic, technological, conceptual systems, effective, and generality. This means that the behavior being intervened on must be of social significance, must be defined in objective terms, the data must demonstrate a strong and clear effect on the specified behavior, it must be possible to replicate the behavior change, and it must show lasting change. ABA has shown widespread success in changing such a large variety of behaviors because of these dimensions and because all behaviors involve similar processes. Additionally, behaviors are

continuously measured throughout the intervention process to assure that the intervention is doing what it is meant to do and if it is not, then changes are made so that it is successful.

ABA has typically been known for its use of individual treatments for Autism intervention. ABA has successfully treated these various behaviors, either by increasing behavioral deficits or decreasing behavioral excesses. For instance, Tereshko and Sottolano (2017) were able to decrease self-injurious behavior in one boy by using an escape extinction procedure. Another example of an application of ABA was done by Hassan et al. (2018) in which the authors were able to use behavioral skills training combined with in situ training in order to help caregivers of children with autism increase their context-specific social skills. The applications of ABA in this type of population, especially with individuals, is arguably the most prominent, however there are many other applications in different settings and with various group sizes.

Many of the preliminary applications of ABA occurred with mental healthcare, especially with populations in mental hospitals. Common interventions used reinforcement procedures (especially token economies), extinction procedures, and shaping in order to eliminate severe problem behaviors displayed in those with severe disorders and to increase desired behaviors such as daily living skills and appropriate social behaviors for instance (Harvey, Luiselli, & Wong, 2009). Many of the behavior analytic research applications in the healthcare setting has specially focused on organizational behavior management (OBM), which is a subfield of ABA in the business and organizational setting. An illustration of the use OBM, in a healthcare setting was done by Cunningham and Geller (2011). The authors used a comprehensive list of techniques for behavioral intervention in order to change healthcare managers response to two common medical errors that were occurring. Results showed

improved prevention of errors as well as improved correction action by managers. This is just one application of OBM/ABA in the workplace, but many more applications exist as well.

A meta-analysis by Houmanfar, Herbst, and Chase (2003) looked at behavior analytic techniques relating to organizational change. The authors found the use of these ABA techniques including prompts, feedback, incentives, and self-monitoring to name a few, have shown a lot of success in demonstrating effective change across a variety of levels in organizational settings and with a large variety of employees. Applications of ABA in the workplace are not just related to organizational change. Another application is called behavior-based safety. A study by Hermann, Ibarra, and Hopkins (2010) successfully improved safety conditions in an automobile parts plant using to behavioral-based safety methods to successfully reduce first-time occupational visits, lost-time, and severity of injuries that did occur. These examples clearly demonstrate that ABA is not only useful for changing an individual's behaviors, but also group behaviors as well, which is extremely relevant for behaviors in society including environmentally sustainable behaviors.

Behavior Analysis and Environmental Sustainability

The application of behavior analysis techniques has been used to influence environmentally sustainable behaviors since the 1970s, however this research is very limited even though it is incredibly important and necessary because of the fact these problems we are experiencing are due to the behaviors of the human population. Because ABA has an obligation to make an impact on socially significant behaviors, it is crucial more professionals in the field dedicate their time to investigating solutions to problems. By coming together with other fields that do spend a substantial portion of their time researching ways to help the environment, behavior analysis can make the biggest impact on getting that done: after all, it is human behaviors that will ultimately solve these problems.

Some applications of research which have utilized different behavior analytic methods such as manipulating motivating operations and response effort, using prompting, incentives, and feedback in order to have an impact on behaviors such as recycling, littering, and energy and gasoline usage. Ludwig, Gray, & Rowell (1998) used response effort to impact recycling behaviors outside of a classroom on a college campus. The authors were successfully able to increase the amount of recycling that was happening simply by making the location of recycling bins more convenient (and therefore less response effort) for students entering and leaving the classroom. Another study that was successful in increasing recycling took place in a neighborhood. Keller (1991) used informational feedback and manipulation of motivating operations to increase the number of houses on one street that participated in recycling by 19%. He did this by putting informational signs containing feedback on how many houses had recycled that week compared to the previous week and stated how if more houses continued to recycle that a gift card would be donated to a local homeless shelter. These two studies demonstrate that these very simple-to-implement and almost no cost techniques of ABA could be used to help make a positive impact on one environmentally relevant behavior.

A study which used a positive reinforcement procedure to reduce college students' gasoline usage was done by Foxx and Hake (1977). They successfully reduced gasoline usage by almost 20% by offering different monetary incentives for various amounts of reduction at the conclusion of the study. Although this method was a bit costlier and required more work to implement, it was able to reduce one of the more serious behaviors that are of significant environmental concern. Another very significant behavior which has been address is the use of disposable single-use items. While recycling does have a positive impact on the environment, most disposable single-use items are not recycled. When thinking of "reduce, reuse, recycle", the biggest impact actually comes from "reducing" usage. Manuel et al. (2007) examined if ABA

techniques would be successful in increasing reusable dinnerware use (as opposed to disposable dinnerware) in a cafeteria. The authors successfully used various ABA techniques including verbal prompting, response effort, and informational feedback to do just this. It was also discovered that not only did all of these methods increase reusable dinnerware usage, but the combination of all three actually had the highest impact. This furthered behavior analytic research as it relates to environmental sustainability by providing evidence that it is necessary to implement many behavior-change strategies to have the largest impact on environmental behaviors.

These studies have provided very important data for researchers who want to make a positive impact on the Earth by using ABA. They demonstrate that it is definitely possible to make the desired impacts across a multitude of environmentally relevant behaviors. They also show that many of the different ABA techniques can be useful in changing these behaviors and that these behaviors can be changed in a variety of settings. While these are important strengths to be noted, it is also necessary to point out the limitations that do exist. Some of these techniques do cost money, which is not always an option in the real world. This is especially true as these studies did not check back to see if any lasting change had happened. It is clear that some of these methods were a lot more involved than others, especially when considering the results from Manuel et al. (2007) that a combination of techniques would have the greatest impact. This is also not always an option in the real world as money, time, and knowledge of implementing ABA will be limited in a lot of areas that need these changes to happen.

Although this research is relevant and important on making progress in understanding ways in which behavior analysis can be used to help improve environmental sustainability, many of these traditional applications of ABA have not yielded the desired large-scale social change that is needed to really improve environmental behaviors (Newsome & Alavosius (2011). One of

the biggest challenges is the fact that these traditional applications have only been done with small sample sizes and groups of people. Methods which change behaviors of very large groups of people, such as a whole community, is what is really needed to make this impact. This poses an additional challenge because individuals have very different beliefs and values when it comes to environmental behaviors. The traditional methods of ABA are difficult to find success in making long-term behavior change in this area is because of the psychological distance that is involved with environmental and sustainable behaviors. Zhang, He, Zhu, & Cheng (2014) describe psychological distance as the effect on probability, temporal, and social distances due to the inability to see consequences in the immediate future due to the reference point of the present moment. For example, direct consequences of environmental behaviors (both positive and negative) can take decades until one is able to see a significant impact as discussed above. This means that some individuals may not see how something could affect them and some individuals will not even be around to experience those consequences. This is especially true when the probability of an impact may be unknown. That makes it less motivating for somebody to make big changes in their daily lives, particularly if that person does not have much time or money in their day to dedicate to making these changes, or if they do not live in or know somebody who lives in an area that is already experiencing detrimental consequences. One way to begin understanding how the field of ABA can make a lasting and positive impact despite these challenges is to look at how people make choices when it comes to sustainable or not sustainable behaviors. This is where discounting research comes into play.

Delay Discounting

Delay discounting research has stemmed from the field of economics and is now very prevalent in the field of behavior analysis, specifically behavioral economics, which is used to help understand decision making behavior as it relates to impulsivity and self-control.

Impulsivity is characterized when one selects the choice containing a smaller, sooner reward as opposed to the choice with the larger, delayed reward (Rachlin & Green, 1972). Impulsivity is many times seen in youth who are still developing (Steinberg et al, 2009), or as a symptom of those who struggle with various types of addiction, personality disorders, eating disorders, and other psychological issues such as obsessive-compulsive disorder and attention deficit hyperactivity disorder (Meda at al., 2009). Impulsivity can have a major impact on the lives of individuals who display it as they are more likely to do something they regret later after experiencing negative consequences of their decision-making. Self-control is the opposite of impulsivity, and therefore is defined as self-regulation or will-power to delay gratification for a later and larger reward (Schuhr, 2016; Critchfield & Kollins, 2001). By having self-control, one is able to make better and more well thought out decisions in order to limit the amount of negative consequences of those choices and maximize the benefits.

Discounting research involves measuring one's impulsivity in responding when presented with a choice of two hypothetical options (Critchfield & Kollins, 2001). It is essentially the process in which one's perceived subjective value of an outcome or reward changes as it becomes further away, despite the fact the actual value of that outcome has not changed (Weatherly et al., 2015). Time is not the only thing that discounting applies to. Social and probability discounting are two other types. Social discounting identifies how the value of an outcome changes based off the social distance of who is affected by that outcome (i.e. how closely it is to the individual responding). Rachlin and Jones (2006) looked at social discounting in which participants were presented with hypothetical scenarios to respond to based off if the outcomes applied to themselves or based off of different numbered people on a list of 100 hundred people, with one being the closest person in their life, to 100 being somebody who they do not know. The authors found that discounting got steeper the further away the social distance.

Probability discounting involves how the value of an outcome changes based on the likelihood of that outcome occurring. Estle, Green, & Myerson (2019) investigated this and discovered that discounting was steeper as the likelihood of that outcome decreased. Even though there are different types of discounting, they are really the same at their core.

Data from discounting research produces a discounting curve, which is identified with the decision-making switch points from responding from the less impulsive option to the more impulsive option and those who tend to respond more impulsively are said to discount at a higher, steeper rate, while those who display more self-control are said to discount at a lower rate (Bialaszek et al., (2019). Results have indicated that discounting research in a laboratory setting has been successful in predicting real-world behaviors and is therefore a great tool for understanding choice responding of individuals (Locey, Jones, and Rachlin, 2011). This is important because it allows for generalizability into real life situations in which people make decisions on a daily basis. By allowing this it means that research can be conducted in these areas without the participants needing to contact particular consequences because the hypothetical situations are sufficient. This will then allow research to be done regarding decision making in a much larger variety of topics. By understanding what factors are involved in the decision-making behaviors of individuals, it makes it possible to find and create methods to reduce impulsivity. Doing this will then help individuals and society as a whole because it can lead to better decision making for everybody's best interest.

Discounting has been used in a plethora of research, especially with applications to addiction, gambling, health behaviors, and other socially relevant behaviors. Friedel et al. (2016) found that smokers discounting health outcomes significantly more steeply than nonsmokers despite knowing the health outcomes were directly related to smoking behaviors. It has also been noted that those who are addicted to cocaine discounted monetary gains much more steeply than

those who were not addicted to cocaine (Mejía-Cruz et al., 2016). Similar to those with chemical addictions, it has been found that those who are pathological gamblers (i.e. those with an addiction to gambling) are also found to discount at a much higher rate than their nongambling counterparts (Dixon et al., 2003). A meta-analysis by Amlung et al. (2017) looked at discounting research done with individuals with various types of additions and found that discounting was significantly steeper for those with more severe addictions than those with less severe addictions. This furthers the knowledge that those struggling with addition, especially severe addiction, indeed have a much more difficult time in delaying gratification, which contributes to their continued poor decision-making even with knowing they are experiencing negative consequences directly related to their addictive behaviors.

A study by Sheffer et al. (2018) investigated discounting of health behaviors among cancer survivors and found that survivors who were further from the time they were diagnosed and those who discounted less displayed significantly healthier behaviors that those who were closer to the time of their diagnosis or who discounted more. Another discounting study that looked at health behaviors was done by Appelhans, Tangney, and French (2019). The authors looked at household food purchasing and evaluated the health quality of the purchases across two weeks. They found that households which discounted more steeply tended to purchase foods that had higher calories and a lower overall Healthy Eating Index-2015 scores. These findings show that discounting research is a very relevant avenue to investigate areas of opportunity to increase both individual and public health concerns to improve the overall quality and longevity of life for individuals, which would have a positive not only for their day-to-day lives, but also for the costs associated with poor health that is a direct result of impulsive choice making. While most discounting research has been done in areas such as those mentioned above, there are still

many more applications that are very relevant to the problems associated with decision making of individuals. One of those areas is environmental sustainability.

Discounting and Environmental Sustainability

Discounting research is especially relevant to investigating human behavior as it relates to environmental sustainability because, despite the general awareness that it is human behavior that has caused these issues and the fact it is human behavior that will solve these issues, there is still a lack of the appropriate and significant behavior change that needs to happen. By using discounting to research environmental decision making it will allow an understanding for how individuals perceive subjective values of outcomes and what it will take to change their decision making to be less impulsive and more conducive to making a positive impact on the Earth.

Carson and Tran (2009) noted the initial costs of climate change mitigation are very high, whereas the benefits that would be seen from those costly measures will not be seen for decades and even centuries. The authors mention how this plays a major role in the lack of large-scale behavior change happening as it is highly dependent on how an individual will respond to those future incentives and it is evident that many individuals display high discounting rates, especially when it comes to their consumer behaviors. Carson and Tran continue to explain how there are obstacles that go beyond the individual's control, such as the information they are consuming, their budget constraints, and even their expectations about the future. When considering the different age groups, socioeconomic statuses, education levels, political beliefs, and geographical living spaces of the current population, it becomes obvious that a deeper understanding is needed for why certain people tend to discount at higher rates than others and what additional factors play into that.

Many of the discounting studies have looked at different types of pollution and how individuals tend to discount in different dimensions as it relates to that pollution. Zhang, He,

Zhu, & Cheng (2014) studied how probability, temporal, and social discounting impacting individuals' valuing of a severity assessment of water pollution and results indicated that both social and probability distance did influence the assessment of severity while temporal distance did not. This is an interesting finding as it helps guide how discounting researchers may want to focus their efforts and what areas are most relevant to target. Another study that looked at discounting as it relates to pollution was done by Berry et al. (2017), in which the authors compared the discounting of monetary gains and losses and the temporary improvement for clean air and found there was indeed a correlation with the discounting rate when it came to both money and clean air. This suggests that the discounting rates of individuals when it comes to money may also be a good indicator of how they will discount choices when it comes to environmental sustainability. A similar study conducted by Berry, Nickerson, and Odum (2017) also evaluated air pollution by using air quality gain and loss as well as respiratory health gain and loss scenarios. Results indicated that participants responded more impulsively for monetary gains as it relates to air quality and health gains, but not to losses. Not only does this also study also provide guidance for research looking at environmental sustainability, but it also furthers discounting research relating to public health.

One last study that is important to note in more detail was done by Kaplan, Reed, and McKerchar (2014) in which the authors analyzed delay, social, and probability discounting of environmental loss with college students. Participants were presented with vignettes of a hypothetical scenario and filled out a discounting questionnaire after each vignette. The scenarios told them to imagine they owned a farm which caught on fire and caused a significant amount of air pollution, which would then go on to pollute the soil and groundwater, putting the farm (and therefore their livelihood) at risk. The delay discounting task asked them how concerned they were and how much time they would devote to solving the problem. For the

social discounting task, they were presented with the same questions, but asked to respond as if the farm was owned by somebody they knew (ranging from 1-100 of how close this individual was). Lastly, the probability discounting task provided the same scenario, but also indicated how much of a percent chance the ground water will contaminate the farm (and impact their livelihood). The results suggested that the expressed concern and the amount of time participants were willing to spend were a function of all three dimensions of discounting and that the discounting of participants' concern were less reliable than the discounting of how much time they would spend fixing the problem across all three dimensions. This study was the first to investigate three dimensions of discounting and how they compare to environmental concern and willingness to spend time directly solving an environmental problem and served as a model for the current study.

Purpose

The purpose of this study is to examine how delay and social discounting impact choice-making when it comes to providing a source of clean water to an individual for a specified amount of money as well as a potential for harm to the environment. Each question asks the participant to respond from the context that the individual is living in Flint, Michigan and has been dealing with the lead-contaminated water crisis for the last five years. This crisis has exposed thousands of its residents, including children, to be exposed to dangerous levels of lead which has caused them to experience rashes, hair loss, and outbreaks of Legionnaires' disease (Mohai, 2018). This scenario was selected due to the fact it would provide more of a real-world situation that the majority of American's are familiar with in hopes that it would inspire deeper thought when answering the questions and therefore more accuracy in choice making. It was hypothesized that discounting would become steeper as both social distance and monetary cost increased, despite there being a higher chance of harm to the environment.

CHAPTER 2

METHODOLOGY

A total of 65 individuals participated in the study. Participants were recruited via social media, email, and personal contacts. Various demographic information was obtained. Ages ranged from 19 to 70, with the average age being 30.5 and the median age being 27. Of the 65 participants, 38 identified as female and 27 identified as male. The majority of participants responded as White (54) for their ethnicity, while four responded as Asian, three as Hispanic, one as Native American or American Indian, and three identified as two or more ethnicities.

Data was also collected on income and political beliefs. 20 participants reported having an annual income of $25-50 thousand, 15 reported having an annual income of $50-75 thousand, 10 reported an annual income of $10-25 thousand, eight reported earning less than $10 thousand per year, six reported earning $75-100 thousand, and six reported an income of over $100 thousand. Of the 27 conservative participants, five identified as being extremely conservative, nine identified as moderate, and 13 identified as slightly conservative. Of the 38 liberal participants, 6 identified as being extremely liberal, 18 as moderate, and 14 as slightly liberal.

The last section of demographic questionnaires asked about how much each participant valued the environment, how often they engaged in sustainable behaviors, and how concerned they were about pollution in the United States. 22 participants reported having an extreme value for the environment, 29 reported a strong value, 10 reported a moderate value, and two reported a slight value. Five participants engaged in sustainable behaviors all the time, 28 frequently, 21 often, and 11 rarely engaged in sustainable behaviors. Lastly, 23 responded having an extreme concern of the environment, 19 reported being very concerned, 19 felt moderately concerned, three were slightly concerned, and one was not concerned at all for pollution in the United States. Demographic and background data of all participants is summarized in Table 1.

All participants consented to participating in the study and all research methods were approved by the university's human subjects committee.

Materials

After consenting, participants were asked to complete a survey which was created using Google Forms. Email addresses were not collected. The first part of this survey asked for demographic information, including gender (female, male, transgender female, transgender male, gender nonconforming, prefer not to say), age, ethnic origin (Asian or Pacific Islander, Black or African American, Hispanic or Latino, Native American or American Indian, White, or other [with a fill-in]), annual income (less than $10,000, $10,000 to $25,000, $25,000 to $50,000, $50,000 to $75,000, $75,000 to $100,000, or over $100,000), political beliefs (extremely conservative, moderately conservative, slightly conservative, slightly liberal, moderately liberal, extremely liberal), amount of value for the environment (extreme, strong, moderate, slightly, none), frequency of behaving in sustainable ways (all the time, frequently, often, rarely, not at all), and concern for pollution in the United States (extremely concerned, very concerned, moderately concerned, slightly concerned, not concerned).

Once the demographic information was collected, participants were provided the following instructions with the first part being similar to a study by Rachlin & Jones (2007):

> *Imagine 100 people, where person 1 is your closest friend of family member, and person 100 is your most distant acquaintance. You will be asked to answer questions based on these varying people.*
>
> *Imagine that person #1 on your lives in Flint, Michigan and has been experiencing the water crisis for the past five years. There was lead in their water source and it was not safe to drink. Drinking the water has caused higher blood-lead levels as well as instances of Legionnaires' Disease. During the time they were forced to purchase*

bottled water to avoid becoming ill. Now imagine that you can donate money to help them continue to have a source of safe water to drink. Select which option you would choose if you were using your own current financial means. There are no right or wrong answers.

These instructions were repeated for all six scenarios, which differed only in the person number for the following options: 1, 20, 40, 60, 80, and 100. Within each of these sections there were 16 discounting questions, each with two options to choose from. Example of the hypothetical questions presented were the following:

Spend $30.00 on 480 12 oz. water bottles that will last them 90 days, but has a 100% chance of hurting the environment, or spend $1000 on a water filtration system that will last them 8 years and has a 0% chance of hurting the environment.

Spend $35.00 on 480 12 oz. water bottles that will last them 90 days, but has a 100% chance of hurting the environment, or spend $1000 on a water filtration system that will last them 8 years and has a 0% chance of hurting the environment.

Spend $40.00 on 480 12 oz. water bottles that will last them 90 days, but has a 100% chance of hurting the environment, or spend $1000 on a water filtration system that will last them 8 years and has a 0% chance of hurting the environment.

The following values were used for the cost of the water bottles: $30.00, $35.00, $40.00, $45.00, $50.00, $55.00, $60.00, $65.00, $70.00, $80.00, $90.00, $100.00, $300.00, $500.00, $700.00, $900.00, and $1,000.00. All questions within the survey needed to be answered in order for the participant to submit their responses and all participants took the survey in the same order.

Data Analysis

Various techniques were used to analyze the data which included both visual and statistical methods. Participant switch points were found for each question and for each section, which was identified when a participant's response changed from selecting the water bottle option to the water filtration system option for each section. This number was then averaged with the dollar value of the response prior to switching. If a participant selected the water bottle option for each choice, then their switch point was marked as zero. If a participant selected the water filtration system option for each choice, then their switch point was marked as 1000. For example, if a participant responded the water filtration system for every question under the section for "Person #1" on their list, then for that section they did not switch and were given the number one. Now if that same participant selected the water bottle option for every question for "Person #40" on their list, up until the option for spending $300 where they then began choosing the water filtration system option, then they were scored as 200. This is because for the $100 option they still chose the filtration system, so the average of 100 and 300 is 200. This switch point was used to find the proportional value for each of the six social distances of all participants, which was then was used to help determine the Area Under the Curve (AUC) value for each participant. These AUC scores were calculated to provide a measurement for the amount of discounting a participant displays and was conducted using the formula provided by Myerson, Green & Warusawitharana (2001):

$$AUC = (X_2 - X_1) \times [(Y_1 + Y_2) \div 2]$$

In this formula, X_1 and X_2 are successive delays while Y_1 and Y_2 are the proportional values which are associated with the delays. Next, a hyperbolic discounting function was used to evaluate the social discounting for the participants as various previous studies have shown that

this function (as opposed to an exponential discounting function) is a better representation of data for discounting. The following formula was used:

$$V = A / (1 + kD)$$

In this formula, V is the observed subjective value, A is the true value, D is the delay, and k is the rate of discounting. After graphing this, the R^2 value was then found to determine the best fit line of the discounting curve, which consisted of the highest value in the range of zero to one, where higher values represent a stronger fit.

The Pearson's product-moment correlation was conducted utilizing Microsoft Excel for Mac, version 16.16.11. A Pearson's correlations can range from -1 to 1, where the closer the value is to the absolute value of 1, the stronger the correlation between the variables. A correlation of -1 or 1 describe perfect correlation between variables, while strong correlations typically range between 0.7 to 1, in either direction, positive or negative. A moderate correlation is 0.5, in either direction, positive or negative. Pearson's correlations were conducted between participant AUC scores and ethnicity, income, political beliefs, the extent to which participants valued the environment, how often they reported behaving in sustainable ways, and how concerned they were with the environment.

CHAPTER 3

RESULTS

Table 2 lays out the mean and median switch points for each of the social distances. Visual analysis suggests the median switch points from selecting the water filtration system option to selecting the water bottle option began to shift starting with the "Person #40" option. This indicates that as social distance increased, more of the participants chose to spend a smaller amount of money to provide clean water, despite it having detrimental effects on the environment. This is especially evident when comparing the "Person #1" option, where 27.69% of participants chose to spend less money, to the "Person #100" option, where 53.8% of participants chose to spend less money. *Figure 1* depicts the median switch points using a logarithmic trend line. The R^2 calculated in *Figure 1* is 0.8633. This demonstrated the hyperbolic discounting function used was a moderately strong fit for the data obtained.

Figure 2 and *Figure 3* display bar graphs for AUC scores. The mean AUC score for participants was 0.683 with the median AUC score being 0.851. The range of AUC scores was 0.094 to 0.995. AUC scores that are close to "0" suggest discounting at a steeper rate, and therefore more impulsive responding, while the scores closer to "1" mean a lesser amount of discounting and therefore more self-control. Data suggest 75% of participants displayed either no discounting or a moderate amount of discounting.

Correlational data is summarized in Table 3. The reported amount in which participants valued the environment and the frequency with which they behaved in sustainable ways had a weak correlation of $r = 0.458$ at the 0.05 significance level. The amount in which participants valued the environment and the amount of concern they had for the environment had a moderate correlation *of* $r = 0.578$ at the 0.05 significance level. The frequency with which participants behaved in sustainable ways and the amount of concern they had for the environment had a weak

correlation of $r = 0.378$ at the 0.05 significance level. Participant AUC scores and the amount in which they valued the environment had a weak correlation of $r = 0.236$, however it was not significant at the 0.05 level. This is noted because it did come close to being significant with $\alpha = 0.058$. All other correlational data were not significant to report.

CHAPTER 4

DISCUSSION

As previously discussed, Baer, Wolf, and Risley (1968) identified seven dimensions that qualify something to be behavior analytic, including being socially significant. There is nothing more socially significant than environmental sustainability and the behaviors that are involved in that. Every being on the planet is affected by the condition of the environment and that makes helping to find viable solutions a responsibility of behavior analysis. This is especially true for the fact that the destruction of the environment that has taken place was due to human activity. Other fields are doing their best to solve these issues, but they can only do so much. Behavior analysis has the ability to help make lasting behavior change. While there have been some attempts at intervening on sustainable behaviors from the field, these have only proven to be effective short-term and for small populations. By understanding what factors are involved in the decision-making process for behaviors that are environmentally relevant, it will be possible to overcome the challenges that exist, which will then help the field to find solutions to have long-lasting behavior change so we can finally make significant progress in saving our Earth.

The current study aimed to look at how participant choice-making changed as it related to social discounting with spending a specified amount of money to provide clean water to somebody while knowing with certainty whether or not that choice will have a negative impact on the Earth. Results did replicate previous findings (ex. Kaplan, Reed, and McKerchar, 2014; Zhang, He, Zhu, & Cheng, 2014) that as social distance increases, so does the amount of participant discounting related to environmental sustainability. Additionally, this study provides more evidence that the hyperbolic function used provides a good fit for social discounting as it applies to decision making as it relates to environmental sustainability.

This study both supports and extends the current literature (Stern et al., 1995; Torres et al., 2016) that individuals who value the environment tend to engage in more environmentally sustainable behaviors more frequently. Not only this, but those who value the environment tend to be more concerned about the condition of the current environment. Moreover, those who are more concerned with the environment tend to behave in environmentally sustainable ways more frequently as was evident by the positive correlations that were identified.

When analyzing how the median switch points changed across the different levels of social closeness, the following results were obtained. On average, for "Person #1" and "Person #20" there was no switching and they were willing to spend the full $1000 to provide those individuals with clean water. For "Person #40", the average switch point happened at $975. Lastly, the remaining choices ("Person #60", "Person #80", and "Person #100") the average switch point happened at the $875 mark. This data suggests that the average participant only valued providing an environmentally sustainable option for clean water to a complete stranger when there was a $125 difference between the options. It is also important to note that even though discounting did increase as social distance increased, there were still 46.2% of respondents were willing to give the maximum amount of money presented of $1000 to provide clean water in an environmentally sustainable way to a complete stranger.

One interesting finding is that 81.5% of participants responded having either a strong or an extreme value for the environment and 73.85% reported being either very or extremely concerned about the environment, but 53.8% still chose the option that cost less money yet had a 100% chance of harming the environment. This provides additional evidence to support what Maio et al. (2009) suggests: many individuals may fail to relate their values with their actions. It also supports the idea that those who did discount more steeply are either experiencing

competing values or are experiencing temporal myopia in that their finances are being valued at a higher level in that moment than their value for the environment.

Strengths and Limitations

There are some strengths and limitations to both the internal and external validity of this study. One strength is that the survey presented participants with specific directions and a scenario to consider when responding to the questions. This insured participants would respond in exact ways that were being asked and not left up to interpretation by the participant. This in turn leads to more accurate data collection for a self-report questionnaire. Additionally, the study was short enough to complete in about 10 minutes, which prevented attrition as well as inaccurate responding since discounting surveys may sometimes be tedious and therefore come with a risk of participants filling out the answers just to finish the survey. The variety of participant demographics as far as age, income, political beliefs, frequency of behaving in environmentally sustainable ways, as well as value and concern for the environment is another particular strength to this study. This is because it is more likely that the sample is better representation of the general population since it is more diverse in these characteristics than a sample size would be.

Although these strengths are important, it is also necessary to discuss the limitations that exist. First and foremost, this was a self-report questionnaire, which always comes with the risk of participants responding in ways that that may not be accurate, whether they are over- or under-reporting by mistake, or because they believe they should respond a particular way and not respond with what is actual true for them (Kimberlin & Winterstein, 2008). As discussed in the previous paragraph, steps were taken to eliminate as much possibility of this occurring as possible. In addition to this survey limitation, the questions were presented in the same order for each participant. This comes with a potential for threats to validity due to order effects. It would

be beneficial to present the questions in different orders to the participants. This will prevent a possibility of order effects from occurring provided participants are presented with a random order of the questions.

Moreover, the survey did not include an option for the participants to respond if they were making this choice for themselves and instead only asked them to respond if they were making this choice for another individual. It would be of value to do this in the future so that more comparisons can be made, especially for those who displayed discounting in the "Person #1" question set. This would also make it possible to determine if individuals respond less impulsively when it comes to themselves compared to others. Another favorable change that could be made is adding more questions that include additional probabilities of harm to the environment as opposed to just the two options of 0% and 100% that were used. This would help to determine if probability discounting has as much as an influence on choice making as social discounting for example. This would also allow for the possibility to see if this would have a factor in to the impulsivity of responding or not and would be very valuable since some behaviors do have a greater probability of harming the Earth than other behaviors.

A further limitation to this study is the fact that a formal environmental values assessment was not utilized, and instead a Likert-type scale was used. Had a more formal assessment been used it would be likely that the data gathered regarding values would be more accurate. This is especially true considering that the correlation of values and AUC scores that were obtained were close to being significant but were not. This could have potentially made the difference in obtaining a significant result. In the future, it would be advantageous to utilize a more formal environmental values assessment. Lastly, the participant selection was not diverse as far as ethnicity or gender identify and it would be very helpful to have more data on a larger variety of individuals that better match the general population. Despite these limitations the

current study was successful in supporting previous literature on social discounting and environmental sustainability.

Future Research

This study is still the beginning of using discounting research to investigate decision making of environmentally sustainable behaviors. It is clear this area of research is important and necessary for understanding what factors have the biggest impact and which are the biggest obstacles to establish a lasting behavior change in this area. By investigating this area further and building on the research that does exist, it would be possible to identify areas that need to be targeted more as well as finding ways this research can be integrated into other fields that are putting in effort to help combat the problem of climate change and pollution.

Future research should aim to identify which dimensions have the biggest impact on decision making, specifically when it comes to time-delay, money, probability, or social discounting. Future research should also evaluate those who are known to behave in impulsive ways and compared that to individuals who do not display particularly impulsive decision making. This would help to determine if there are certain populations that are prone to behaving in ways that are not sustainable as well as to identify what avenues to spend more time researching extensively and target specific obstacles behavior analysts and policy-makers need to overcome. In order to do this, it would be meaningful to conduct studies in a similar fashion to Kaplan, Reed, and McKerchar (2014), but with different sustainable behaviors, as the authors were successful in researching the different dimensions of discounting. For example, if it is found that individuals tend to discount more steeply when it comes to social closeness compared to the other dimensions, then fields such as social marketing can find ways to make environmental sustainability seem more relevant to the population. Geller (1989) suggests that aba should be integrated with social marketing which would help to change not just the

behaviors themselves, but to also find ways to change attitudes on sustainable practices in the members of society. This is crucial for widespread behavior-change because it targets peoples' beliefs and values, which has been found to be a better predictor of environmentally sustainable behaviors than other factors (Granzin & Olsen, 1992).

Another way which aba can seek to change individuals' values and likelihood to behave in line with those values as they relate to the environment is through Acceptance and Commitment Therapy (ACT). ACT utilizes six processes in order to increase psychological flexibility: acceptance, values, committed action, defusion, present moment, and self-as-context (Hayes et al., 2006). By doing this it would help individuals to act in ways which are committed to their values. This would help to combat the finding of Maio et al. (2009) and of the present study that shows people fail to relate their actions to their values. This would be a major obstacle that can be overcome so that it is possible to see large-scale behavior change.

Another valuable way to integrate different disciplines with aba which would be helpful in determining if values or discounting shows any patterns in different geographical locations is with Geographic Information Systems (GIS). GIS is the spatial data analysis of various types of information in order to identify patterns across different locations (Bodenhamer, Corrigan. & Harris, 2010). This would be especially helpful not only to understand if those who live in different communities behave, discount, or value the environment differently, but also to identify areas that need additional support and behavioral intervention. This would be very useful for policy-makers who seek to make a positive impact on the environment by targeting areas where they can fight for those changes in policy and identify areas that need more funds to be allocated towards implementing these changes. By different fields coming together and researching with aba it would be possible to make the largest impact possible, which is exactly what is needed at this time.

The current study sought to look at the relationship between decision-making, social discounting, and environmentally sustainable behaviors. This, along with other discounting research, is beginning to understand how to investigate these challenges in behavioral research when it comes to environmental sustainability. This will be an integral part in fully understanding the obstacles that stand in the way of large-scale behavior change and identifying areas of opportunity to overcome these obstacles. As more research is conducted and as aba and other fields begin to come together, it will allow us to tackle the problem of climate change and pollution in a more meaningful way so that we can begin to repair the damage that human behaviors have had on this Earth.

REFERENCES

Aldred, J. (2008, February 28). Q&A: Plastic bags. *The Guardian.* Retrieved from http://www.guardian.co.uk

Amlung, M., Vedelago, L., Acker, J., Balodis, I., & MacKillop, J. (2017). Steep delay discounting and addictive behavior: a meta-analysis of continuous associations. *Addiction, 112*(1), 51-62.

Applehans, B. M., Tangney, C. C., French, S. A., Crane, M. M., & Wang, Y. (2019). Delay discounting and household food purchasing decisions: the shopper study. *Health Psychology, 38*(4), 334-342. doi: 10.1037/hea0000727

Auffhammer, M. (2018). Quantifying economic damages from climate change. *Journal of Economic Perspectives, 32,* 33-52. doi: 10.1257/jep.32.4.33

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91-97.

Baulch, S., & Perry, C. (2014). Evaluating the impacts of marine debris on cetaceans. *Marine Pollution Bulletin*, *80*(1/2), 210-221.

Berry, M. S., Friedel, J. E., DeHart, W. B., Mahamane, S., Jordan, K. E., & Odum, A. L. (2017). The value of clean air: comparing discounting of delayed air quality and money across magnitudes. *Psychological Record, 67*(2), 137-148.

Bialaszek, W., Ostaszewski, P., Green, L., & Myerson, J. (2019). On four types of devaluation of outcomes due to their costs: delay, probability, effort, and social discounting. *Psychological Record, 69*(3), 415. doi: 10.1007/s40732-019-00340-x

Bodenhamer, D. J., Corrigan, J., & Harris, T. M., (2010). The spatial humanities: gis and the future of humanities scholarship. Bloomington, IN: Indiana University Press.

Browne, M. A., Niven, S. J., Galloway, T. S., Rowland, S. J., & Thompso, R. C. (2013). Microplastic moves pollutants and additives to worms, reducing functions linked to health and biodiversity. *Current Biology, 23*, 2388-2392.

Berry, M. S., Nickerson, N. P., & Odum, A. L. (2017). Delay discounting as an index of sustainable behavior: devaluation of future air quality and implications for public health. *International Journal of Environmental Research and Public Health*, 14, 997. doi: 10.3390/ijerph14090997

Carson, R. T., & Tran, R. B. (2009). Discounting behavior and environmental decision. *Journal of Neuroscience, Psychology, and Economics, 2*(2), 112-130.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007) Applied behavior analysis. New York, NY: Pearson Education, Ltd.

Critchfield, T. S., & Kollins, S. H. (2001). Temporal discounting: basic research and the analysis of socially important behavior. *Journal of Applied Behavior Analysis, 34*(1), 101-122.

Cunningham, T. R., & Geller, E. S. (2011). What do healthcare managers do after a mistake? Improving responses to medical errors with organizational behavior management. *Journal of Communication in Healthcare, 4*(2), 70-87.

Detloff, K., & Istel, K. (2016). Plastic oceans. *Journal of Ocean Technology, 11*(2), 1.

Dixon, M. R., Marley, J., & Jacobs, E. A. (2003). Delay discounting by pathological gamblers. *Journal of Applied Behavior Analysis, 36*, 449-458.

Environmental Protection Agency. (n.d.a). Climate change impacts. Retrieved from https://19january2017snapshot.epa.gov/climate-impacts_.html

Environmental Protection Agency. (n.d.b). Climate change indicators: weather and climate. Retrieved from https://www.epa.gov/climate-indicators/weather-climate

Environmental Protection Agency. (n.d.c). Municipal solid waste landfills. Retrieved from http://www.epa.gov/landfills/municipal-solid-waste-landfills

Estle, S. J., Green, L., & Myerson, J. (2019). When immediate losses are followed by delayed gains: additive hyperboloid discounting models. *Psychonomic Bulletin & Review, 26*(4), 1418-1425.

Fourth National Climate Assessment. (2018). Climate science special report. Retrieved from https://science2017.globalchange.gov

Foxx, R. M., & Hake, D. F. (1977). Gasoline conservation: a procedure for measuring and reducing the driving of college students. *Journal of Applied Behavior Analysis, 10*(1), 61-74.

Friedel, J. E., DeHart, W. B., Frye, C. C. J., Rung, J. M., & Odum, A. L. (2016). Discounting of qualitatively different delayed health outcomes in current and never smokers. *Experimental and Clinical Psychopharmacology, 24*(1), 18-29.

Geller, E. S. (1989). Applied behavior analysis and social marketing: an integration for environmental preservation. *Journal of Social Issues, 45*(1), 17-36.

Geyer, R., Jambeck, J. R., Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances, 3*(7).

Giljum, S., Hinterberger, F., Burger, E., Fruehmann, J., Lutter, S., …, & Warhurst, M. (2009). Overconsumption? Our use of the world's natural resources. *Friends of the Earth Europe.*

Granzin, K. L., & Olsen, J. E. (1991). Characterizing participants in activities protecting the environment: a focus on donating, recycling, and conservation behaviors. *Journal of Public Policy & Marketing,* (2), 1.

Hansmann, R, Mieg, H. A., & Frischnecht, P. (2012). Principal sustainability components: empirical analysis of synergies between the three pillars of sustainability. *International Journal of Sustainable Development & World Ecology, 19*, 451-459. doi: 10.1080/13504509.2012.696220

Harvey, M. T., Luiselli, J. K., & Wong, S. E. (2009). Application of applied behavior analysis to mental health issues. *Psychological Services,* (3), 212.

Hassan, M., Simpson, A., Danaher, K., Haesen, J, Makela, T., & Thomson, K. (2018). An evaluation of behavioral skills training for teaching caregivers how to support social skill development in their children with autism spectrum disorder. *Journal of Autism & Developmental Disorders, 48*(6), 1957-1970.

Hayes, S. C., Luoma, J. B., Bond, F., W., Masuda, A., & Lillis, J. (2006) Acceptance and commitment therapy: model, processes and outcomes. *Behaviour Research and Therapy, 44*, 1-25. doi: 10.1016/j/brat.2005.06.006

Hermann, J. A., Ibarra, G. V., & Hopkins, B. L. (2010). A safety program that integrated behavior-based safety and traditional safety methods and its effects on injury rates of manufacturing workers. *Journal of Organizational Behavior Management,* (1), 6.

Houmanfar, R., Herbst, S. A., & Chase, J. (2003). Organizational change applications in behavior analysis: A review of the literature and future directions. *The Behavior Analyst Today, 4*(1), 59-65. doi: 10.1037/h0100011

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, Al, … Law, K. L. (2015). Marine pollution, Plastic waste inputs from land into the ocean. *Science (New York, N. Y.), 347*(6223), 768-771.

Kaplan, B., Reed, D., & McKerchar, T. (2014). Using a visual analogue scale to assess delay, social, and probability discounting of an environmental loss. *Psychological Record, 64*(2), 261-269. doi: 10.1007/s40732-014-0041-z

Keller, J. J. (1991). The recycling solution: how I increased recycling on Dilworth road. *Journal of Applied Behavior Analysis, 24*(4), 617-619.

Kimberlin, C. L, & Winterstein, A. G. (2008). Validity and reliability of measurement instruments used in research. *American Journal of Health-System Pharmacy, 65*(23), 2276-2284.

Kurtela, A., & Antolovic, N. (2019). The problem of plastic waste and microplastics in the seas and oceans: impact on marine organisms. *Croatian Journal of Fisheries, 77*(1), 51, 51-56.

Locey, M. L., Jones, B. A., & Rachlin, H. (2011). Real and hypothetical rewards in self-control and social discounting. *Judgement & Decision Making, 6*(6), 552-564.

Ludwig, T. D., Gray, T. W., & Rowell, A. Increasing recycling in academic buildings: a systematic replication. (1998). *Journal of Applied Behavior Analysis, 31*(4), 683-686.

Luke, M., & Alavosius, M. (2012). Impacting community sustainability through behavior change: a research framework. *Behavior and Social Issues, 21,* 54-79.

Mejía-Cruz, D., Green, L., Myerson, J., Morales-Chaine, S., & Nieto, J. (2016). Delay and probability discounting by drug-dependent cocaine and marijuana users. *Psychopharmacology, 233*(14), 2705-2714.

Maio, G. R., Hahn, U., Frost, J. M., & Cheung, W. Y. (2009). Applying the value of equality unequally: effects of value instantiations that vary typicality. *Journal of Personality and Social Psychology, 97*(4), 598-614. doi: 10.1037/a0016683

Maio, G. R., Olson, J. M., Vernard, M. M., & Luke, M. A. (2003). Ideologies, values, attitudes, and behavior. *Handbook of social Psychology*. Springer Nature/ Books.

Manuel, J. C., Anne Sunseri, M., Olson, R., & Scolari, M. (2007). A diagnostic approach to increase reusable dinnerware selection in a cafeteria. *Journal of Applied Behavior Analysis, 40*(2), 301-310.

Matsuguma, Y., Takada, H., Kumata, H., Kanke, H., Saurai, S., Suzuki, T., … & Zakaria, M. P. (2017). Microplastics in sediment cores from asia and Africa as indicators of temporal trends in plastic pollution. *Archives of Environmental Contamination and Toxicology,* (2), 230. doi: 10.1007/s00244-017-0414-9

McNerney, J. (2019). What are we doing about climate change? Obstacles, opportunities, and legislative action. *The Humanist*, (2), 12

Meda, S. A., Stevens, M. C., Potenza, M. N., Pittman, B., Gueorguieva, R., Andrews, M. M., … & Pearlson, G. D. (2009). Investigating the behavioral and self-report constructs of impulsivity domains using principal component analysis. *Behavioural Pharmacology,* (5/6), 390.

Mohai, P. (2018). Environmental justice and the flint water crisis. *Michigan Sociological Review, 32,* 1-41.

Moore, C. J. (2008) Synthetic polymers in the marine environment: a rapidly increasing, long-term threat. *Environmental Research 108*(2), 131-139.

Myerson, J., Green, L., & Warusawitharana, M. (2001). Area under the curve as a measure of discounting. *Journal of the Experimental Analysis of Behavior,* (2), 235. doi: 10.1901/jeab.2001.76-235

NASA. (2019). The effects of climate change. Retrieved from https://climate.nasa.gov/effects/

Nerland, I. L., Halsband, C., & Thomas, K. V. (2014). Microplastics in marine environments: occurrence, distribution and effects. *Norwegian Institute for Water Research*.

Newsome, W., and Alavosius, M. (2011). Toward the prediction and influence of environmentally relevant behavior: seeking practical utility in research. *Behavior and Social Issues, 20,* 44-71.

Rachlin, H., & Green, L. (1972). Commitment, choice, and self-control. *Journal of the Experimental Analysis of Behavior, 17*, 15–22.

Rachlin, H. & Jones, B. (2006). Social Discounting. *Psychological Science,* 17(4),283-286.

Rachlin, H., & Jones, B. (2007). Social discounting and delay discounting. *Journal of Behavioral Decision Making, 21*, 29-43.

Robb, H. (2007). Values as leading principles in acceptance and commitment therapy. *International Journal of Behavioral Consultation and Therapy, 3*(1), 118-122.

Schuhr, A. (2016). Seizing control: estimating multiple decision processes and the investigation of self-control. *Basic & Applied Social Psychology, 38*(5), 241-257. doi: 10.1080/01973533.2016.1207174

Sheffer, C. E., Miller, A., Bickel, W. K., Devonish, J.A., O'Connor, R. J., Wang, C., …, & Gage-Bouchard, E. A. (2018). The treasure of now and an uncertain future: delay discounting and health behaviors among cancer survivors. *CANCER, 124*(24), 4711-4719.

Steinberg, L., Graham, S., O'Brien, L., Woolard, J., Cauffman, E., & Banich, M. (2009). Age differences in future orientation and delay discounting. *Child Development, 80*, 28-44.

Stern, P. C., Kalof, L., Dietz, T., & Guagnano, G. A. (1995). Values, beliefs, and pro-envrionmental action: attitude formation toward emergent attitude objects. *Journal of Applied Social Psychology, 19*, 255-265.

Sustainable Foodservice Consulting. (2016). Restaurant waste reduction. Retrieved from http://www.sustainablefoodservice.com/cat/waste/htm

Tereshko, L., & Sottolano, D. (2017). The effects of an escape extinction procedure using protective equipment on self-injurious behavior. *Behavioral Interventions, 32*2), 152-159.

Torres, P. C., Morsello, C., Parry, L., & Pardini, R. (2016). Who cares about forests and why? Individual values attributed to forests in a post-frontier region in Amazonia. *PLoS One, 11*(12).

UNEP/WHO/IAEA. (1988). Guidelines for monitoring the quality of coastal recreational and shellfish areas. *Preference Methods for marine Pollution Studies 1*(1).

United State House of Representatives. (June 6, 2019). Hearing: the costs of climate change – risks to the U.S. economy and the federal budget. Retrieved from https://budget.house.gov/publications/report/hearing-costs-climate-change-risks-us-economy-and-federal-budget

Van Cauwenberghe, L., Devriese, L., Galgani, F., Robbens, J., & Janssen, C. R. (2015). Microplastics in sediments: a review of techniques, occurrence and effects. *Marine Environmental Research, 111*, 5-17.

Weatherly, J., Petros, T., Jonsdottir, H., Derenne, A., & Miller, J. (2015). Probability alters delay discounting, but delay does not alter probability discounting. *Psychological Record, 65*(2), 267.

Wittmann, M., & Sircova, A. (2018). Dispositional orientation to the present and future and its role in pro-environmental behavior and sustainability. *Heliyon, 4*(10), e00882.

Zhang, W., He, G., Zhu, Y., & Cheng, L. (2014). Effects of psychological distance on assessment of severity of water pollution. *Social Behavior and Personality, 42*(1), 69-

APPENDICES

APPENDIX A

TABLES

Table 1. Summary of participant demographic and background

Age	**N**	**%**
18-21	4	6.15
22-29	41	63.08
30-39	12	18.46
40-49	2	3.08
50-59	5	7.69
60-69	0	0
70-79	1	1.54
Gender	**N**	**%**
Female	38	58.46
Male	27	41.54
Transgender female	0	0
Transgender male	0	0
Gender non-conforming	0	0
Prefer not to say	0	0
Ethnicity	**N**	**%**
White	54	83.08
Hispanic/Latino	3	4.62
Black/African American	0	0
Native American/American Indian	1	1.54
Asian/Pacific Islander	4	6.15
Multi-racial	3	4.62
Annual Income	**N**	**%**
Less than $10,000	8	12.31
$10,000 - $25,000	10	15.38
$25,000 - $50,000	20	30.77
$50,000 - $75,000	15	23.08
$75,000 - $100,000	6	9.23
More than $100,000	6	9.23
Political Beliefs	**N**	**%**
Extremely conservative	5	7.69
Moderately conservative	9	13.85
Slightly conservative	13	20.00
Slightly liberal	14	21.54
Moderately liberal	18	27.69
Extremely liberal	6	9.23
Amount of Value for the Environment	**N**	**%**
Extreme value	22	33.85
Strong value	29	44.62

Moderate value	10	15.38
Slight value	2	3.08
No value	0	0
Frequency of Engaging in Sustainable Behaviors	N	%
All the time	5	7.69
Frequently	28	43.08
Often	21	32.31
Rarely	11	16.92
Never	0	0
Amount of Concern for the Environment	N	%
Extremely concern	23	35.38
Very concerned	19	29.23
Moderately concerned	19	29.23
Slightly concerned	3	4.62
Not concerned	1	1.54

Table 2. Switch points for each social distance

Social Distance (Person #)	# 1	# 20	# 40	# 60	# 80	# 100
Median	1000	1000	1000	950	950	950
Mean	772.38	687.88	676.65	664.96	687.31	682.77

Table 3. Summary of correlational data

Variables	R	Sig. Level
AUC & Gender	0.218	0.081
AUC % Age	0.139	0.270
AUC & Ethnicity	0.135	0.283
AUC % Income	0.144	0.254
AUC & Political Beliefs	0.085	0.503
AUC & Value for Environment	0.236	0.058
AUC & Behavior	0.153	0.223
AUC & Concern for Environment	0.224	0.073
Value & Behavior	0.458	0.000
Value & Concern	0.578	4.51E-07
Behavior & Concern	.0378	0.002
Political Beliefs & Behavior	0.071	0.574
Age & Behavior	0.203	0.105

APPENDIX B

FIGURES

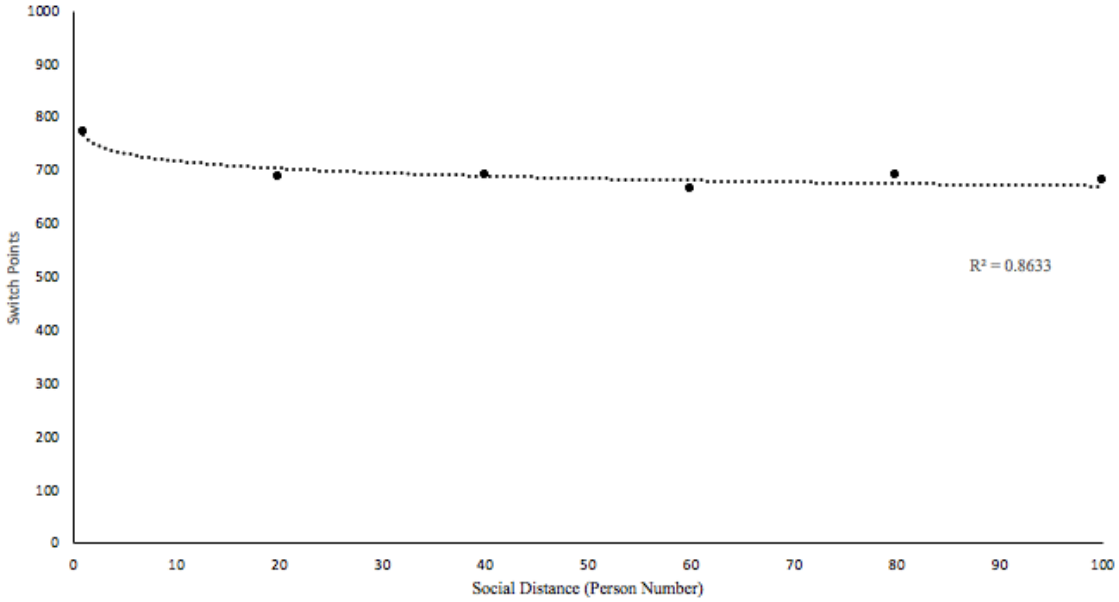

Figure 1. Switch points with logarithmic trendline

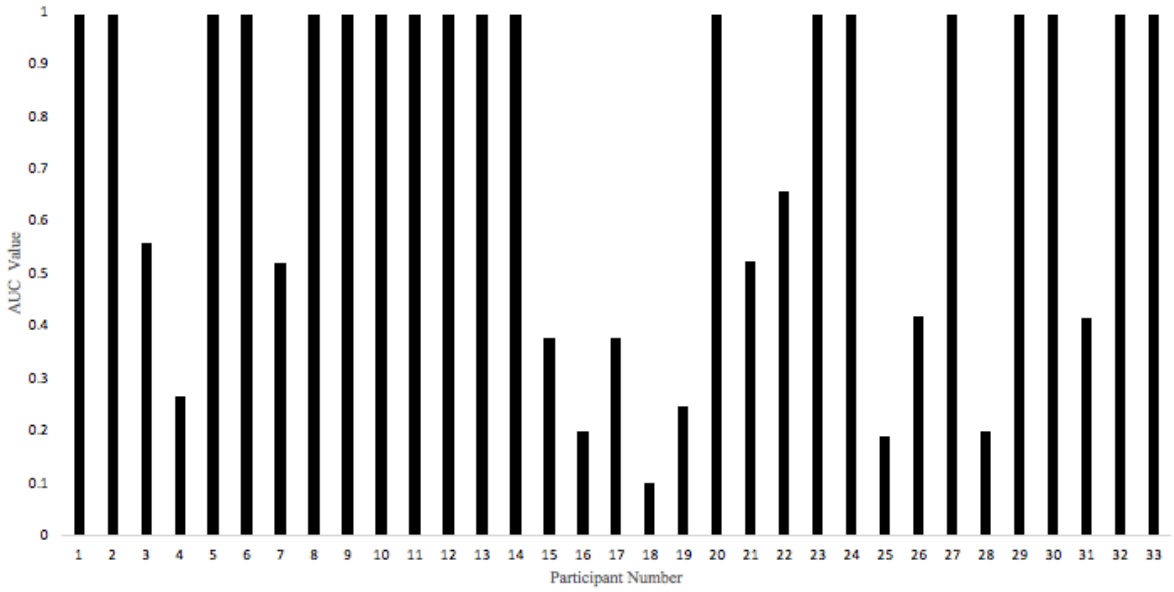

Figure 2. Bar graph displaying AUC values for participants 1-33

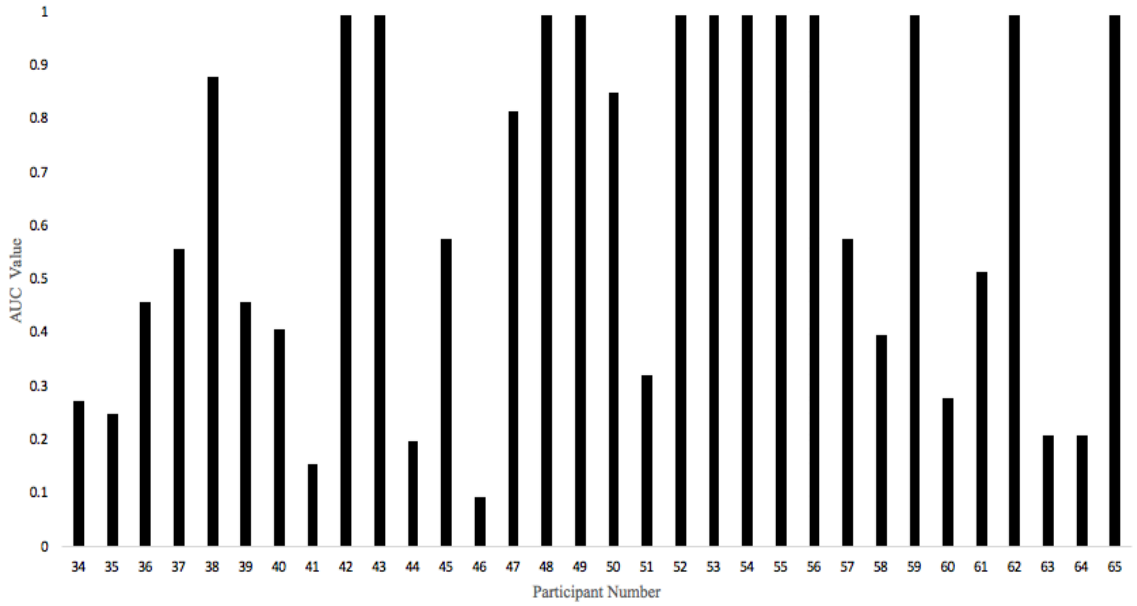

Figure 3. Bar graph displaying AUC values for participants 34-65

APPENDIX C

SOCIAL DISCOUNTING AND CLEAN WATER SURVEY

Imagine 100 people, where person 1 is your closest friend or family member, and person 100 is your most distant acquaintance. You will be asked to answer questions based on these varying people.

(Person #X)

Imagine that person #X on your list lives in Flint, Michigan and has been experiencing the water crisis for the past five years. There was lead in their water source and it was not safe to drink. Drinking the water has caused higher blood-lead levels as well as instances of Legionnaires' Disease. During this time they were forced to purchase bottled water to avoid becoming ill. Now imagine that you can donate money to help them continue to have a source of safe water to drink. Select which option you would choose if you were using your own current financial means. There are no right or wrong answers.

OPTION A: Spend $30.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $35.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $40.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $45.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $50.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $55.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $60.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $65.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $70.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $80.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $90.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $100.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.

OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $300.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $500.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $700.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $900.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.
OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

OPTION A: Spend $1000.00 on 480 12 oz. water bottles that will last them 90 days but has a 100% chance of hurting the environment.

OPTION B: $1000 on a water filtration system that will last 8 years and has a 0% chance of hurting the environment.

VITA

Graduate School
Southern Illinois University

Ashley Monique Katz

ashleymoniquekatz@gmail.com

Illinois State University

Bachelor of Science, Psychology, December 2015

Thesis Paper Title:
Social Discounting of Clean Water and Environmental Sustainability

Major Professor: Dr. Mark Dixon